



LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

CFA12 | Waddesdon and Quainton

Water resources assessment (WR-002-012)

Water resources

November 2013

ES 3.5.2.12.13

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Department for Transport

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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 The water resources and flood risk assessment appendices (Volume 5) comprise three parts. The first of these is a route-wide appendix (Volume 5: Appendix WR-001-000).

1.1.2 Specific appendices for each community forum area (CFA) are also provided. For the Waddesdon and Quainton area (CFA12) these are:

- a water resources assessment (i.e. this appendix); and
- a flood risk assessment (Volume 5: Appendix WR-003-012).

1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5, Water Resources and Flood Risk Assessment Map Book.

1.2 Study area

1.2.1 The Waddesdon and Quainton area (CFA12) covers approximately 10km of the Proposed Scheme in Aylesbury Vale District, from just south of the A41 Bicester Road to the north-western tip of Sheephause Wood, south-west of Calvert. The area includes land in parts of the Waddesdon, Quainton, Grendon Underwood and Calvert Green parishes.

1.2.2 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the centre line of the route, except where there is clearly no hydraulic connectivity. For surface water features in urban areas, the extent was reduced to 500m. Outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centre line, for example at stations and depots, professional judgement has been used in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this spatial scope is defined as the study area.

1.2.3 The main environmental features of relevance to water resources and flood risk assessment include:

- tributaries of the Fleet Marston Brook (a tributary of the River Thame);
- the River Ray and its tributaries: Tetchwick Brook, Doddershall Brook and Muxwell Brook;
- three sites of special scientific interest (SSSI): Finemere Wood, Sheephause Wood, and Grendon and Doddershall Woods;
- the Grendon and Doddershall Meadows local wildlife site (LWS); and

- superficial deposits comprising Alluvium and Head which may contain shallow groundwater.

1.2.4 Key environmental issues relating to water resources and flood risk assessment include:

- construction in close proximity to the old landfill site boundary of the Calvert landfill site at the northern boundary of the Waddesdon and Quainton area;
- the potential impacts of culvert crossings;
- track drainage discharging to surface water features, or draining shallow groundwater; and
- the diversion of several drains including the drain at Cross Roads Farm, Doddershall Brook and Muxwell Brook.

1.2.5 Where a residual impact or mitigation impact to water resources has a consequent effect on ecology, this is discussed further in Volume 2, Waddesdon and Quainton (CFA report 12), Section 7.

2 Stakeholder engagement

2.1.1 Discussions have been held with the following stakeholders to inform the water resources assessment:

- Environment Agency in relation to the crossing of watercourses by elements of the Proposed Scheme, and in relation to the potential impacts of cuttings;
- private licensees by informing them of the Proposed Scheme and requesting information on their licensed abstractions in a questionnaire to more accurately assess and understand any potential risks to the private abstraction; and
- Fomento de Construcciones y Contratas Environment Ltd who are the operators of the Calvert landfill.

3 Baseline data

3.1 General

- 3.1.1 The following section provides a current description of water resources including surface water and groundwater.
- 3.1.2 Water bodies to the west of Waddesdon fall within the River Cherwell sub-catchment of the Thames River Basin District (RBD) as defined under the Water Framework Directive¹ (WFD) and are covered by the associated River Basin Management Plan² (RBMP). To the east of Waddesdon the water bodies fall within the Thame and South Chilterns sub-catchment of the Thames RBD and are covered by the associated RBMP.

3.2 Surface water features

- 3.2.1 All surface water features within 1km of the route³ are presented in Table 1.
- 3.2.2 The current surface water baseline and water features with codes listed in Table 1 are shown in Maps WR-01-016 and WR-01-017 (Volume 5, Water Resources and Flood Risk Assessment Map Book). If the feature has a specific reference number then this is provided (e.g. a surface water crossing will be referenced as SWC-CFA12-01). If the feature has no specific reference its location on a specific map is provided (e.g. WR-01-012, D6) where D6 is a grid reference using the map specific grid.
- 3.2.3 The surface water features are based on the Environment Agency's Detailed River Network (DRN) with the addition of water bodies noted on the Ordnance Survey's (OS) 'OS VectorMapDistrict'.

¹ Water Framework Directive - Directive 200/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Strasbourg, European Parliament and European Council

² Environment Agency (2009) River Basin Management Plan, Thames River Basin District.

³ The Environment Agency's Detailed River Network (DRN) shows the route to cross a culverted watercourse (Map WR-01-002). The watercourse has been included in the DRN to ensure connectivity. It is considered that any such watercourse is a part of the sewer network and is not a surface water feature. It has therefore not been included in this assessment.

Table 1: Surface water features within 1km of the route in the study area

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Three unnamed ponds	Isolated field ponds near Cranwell Farm 300m south of A41 at CFA12/CFA11 boundary (ponds will be 130m, 300m and 420m south of the route). (CFA12-P01)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water features in the catchment.
Unnamed pond	Isolated field pond will be 650m north of the route, east of Lower Blackgrove Farm. (CFA12-P02).	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water features in the catchment.
Unnamed drain	Unnamed drain north of Lower Blackgrove Farm (will be 650m from the route). Connects into the tributary of the Fleet Marston Brook.	Ordinary watercourse	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	Not applicable	Not applicable	The drain flows through a culvert to the north and joins the tributary drain of the Fleet Marston Brook to the north, via culvert. Located well outside the construction footprint of the Proposed Scheme.
Tributary of Fleet Marston Brook	Field drain will be approximately 670m north of the route, north of Lower Blackgrove Farm.	Ordinary watercourse	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	0.0007	0.78	Joins the Fleet Marston Brook 840m north of Lower Blackgrove Farm.

⁴ Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a main river as a watercourse that is shown as such on a main river map. Section 72 of the Land Drainage Act 1991 defines an ordinary watercourse as 'a watercourse that is not part of a main river'. Section 221 of the Water Resources Act 1991 defines a watercourse as including 'all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. Main rivers are larger rivers and streams designated by Defra on the main river map and are regulated by the Environment Agency.

⁵ For examples of receptor value, see Table 43 in the Scope and Methodology Report (SMR) Addendum, Volume 5: Appendix CT-001-000/2.

⁶ Q95 is the flow which is exceeded for 95% of the time (i.e. it is a low flow and the river will only have flows less than this for 5% of the time).

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Unnamed drain	Adjacent to A41 380m east of A41 junction with Waddesdon Hill and will be 160m south of the route	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drain as shown on OS mapping is not connected to any other surface water features in the catchment. Possibly part of the A41 road drainage as it lies between lay by and main carriageway.
Two unnamed ponds	Isolated field ponds to the north of Wayside Farm (will be 35m and 200m north of the route) 80m south of SWC-CFA12-13. (CFA12-Po4)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Unnamed pond	Isolated farm pond at Wayside Farm (will be 70m – 130m south of the route). (CFA12-Po4).	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond not connected to any other surface water feature.
Unnamed pond	Isolated field pond south of Lapstone House (will be 310m north of the route). (CFA12-Po5).	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water feature.
Two unnamed ponds	Isolated field ponds east of Briar Hill Farm (will be 140m and 515m south of the route). (CFA12-Po6)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Unnamed drain (Waddesdon)	Drainage channel in eastern part of Waddesdon will be approximately 750m south of the route.	Ordinary watercourse	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	0.0005	0.52	Flows southwards away from proposed route to Wormstone and then on to join other tributaries of the River Thame.
Unnamed pond	Isolated field pond south of the sewage treatment works, will be crossed by the route to the north of Glebe Farm. (CFA12-Po7) and (SWC-CFA12-14)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water feature.
Five unnamed ponds	Isolated field ponds to the north of Waddesdon near Glebe Farm (will be 200m – 470m south of the route). (CFA12-Po8)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Unnamed pond	Isolated field pond to the north of the sewage treatment works (will be approximately 560m north of the route). (CFA12-Po9)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water feature.
Unnamed drain and five unnamed ponds	Isolated field ponds and one drain south of the route between Littleton Middle Farm and Little Manor Holding (will be 500m – 800m south of the route). (CFA12-P10)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds and drain are not connected to any other surface water feature. The drain ends in one of the ponds.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Headwaters of Fleet Marston Brook	The Fleet Marston Brook will be crossed by the route to the north of Waddesdon. Flowing north-east/east. (SWC-CFA12-01)	Main river	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	0.001	1.3	The crossing is close to the headwaters of the Fleet Marston Brook (which rises from issues about 190m to the south-west of this crossing). It is a small brook flowing in a broad arc from north to south. It joins the River Thame immediately north of the route near SWC-CFA11-13 in CFA11.
Two unnamed drain	Two isolated field drains north of Littleton Middle Farm (will be 150m to 250m and 650m to 850m south of the route).	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The field drains are not connected to any other surface water feature.
Unnamed pond	Isolated field pond adjacent to Station Road (will be 230m south of the route) near Buckinghamshire Railway Centre. (CFA12-P11)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water feature.
Three unnamed ponds	Three isolated field ponds to the east of Buckinghamshire Railway Centre will be approximately 500 to 820m east of the route. (CFA12-P12)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Unnamed pond	Isolated field pond to the south of Crossroads Farm, approximately 205m south of the route. (CFA12-P13)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The pond is not connected to any other surface water feature.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Two tributaries of the Tetchwick Brook	Two tributaries of the Tetchwick Brook cross the route (SWC-CFA12-02 and SWC-CFA12-03) west of Buckinghamshire Railway Centre. In addition, there will be two crossings 216m and 360m south of the route (SWC-CFA12-15 and SWC-CFA12-16) and one 150m north of the route (SWC-CFA12-17).	Ordinary watercourse	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	0.0003	<0.5	The drains converge in the vicinity of Crossroads Farm and then flow south-west to join the Tetchwick Brook some 2.9km west of the route.
Three unnamed pond	Three isolated field ponds will be to the north of the route (575 – 1km from the route) near Fieldside Farm. (CFA12-P14)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Six unnamed ponds	A group of six small ponds (will be 0m – 100m south of the route) west of Upper South Farm. (CFA12-P15) and (SWC-CFA12-18).	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds occupy disused clay workings and are not connected to any other surface water feature.
Unnamed drain	Drain which crosses the route to the north of Upper South Farm. Drain connects two small ponds to the north of Upper South Farm (CFA12-P16). (SWC-CFA12-04)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drain is not connected to any other surface water feature.
Four ponds	Two small field ponds 60m east and 70m west (part of earthworks) of the route with a connecting drain which crosses the route to the north of Upper South Farm. Two smaller field ponds are also close to the route.	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
	(CFA12-P16)							
Two unnamed ponds	Two isolated field ponds to the west of Lower South Farm, which will be approximately 630m south of the route. (CFA12-P17)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Unnamed drains	Unnamed drains located north-east of Doddershall House. They flow southwards and will be crossed by the route at SWC-CFA12-05, SWC-CFA12-06, SWC-CFA12-07 and SWC-CFA12-08. There will be a further crossing (SWC-CFA12-19) 90m south of the route.	Ordinary watercourse	No status class shown in the RBMP – assumed status Poor	No status class shown in the RBMP – assumed status Good	Moderate	0.0008	1.61	The field drains merge just south of the route and flow to the east of Doddershall House before eventually joining Tetchwick Brook.
Twelve unnamed ponds	Approximately 12 small ponds that will be from 500m south to 1km north of the route near Doddershall House and Shipton Lee. (CFA12-P18)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	They are not connected to any other surface water feature.
Unnamed drain	Unnamed drain running south-west to north-east near Shipton Lee, will be approximately 690m – 1km north of the route.	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drain is not connected to any other surface water feature.
River Ray	Will be crossed by the route near Woodlands Farm. (SWC-CFA12-09)	Main river	Ray and tributaries, Northeast of Grendon Underwood	Good	High	0.002	4.5	

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
			GB106039030100 Moderate					
Five unnamed ponds	Approximately five ponds surrounding Woodlands Farm from adjacent to the route up to 300m north and south. (CFA12-P19)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
One unnamed Pond	One pond surrounding Woodlands Farm will be just south of the route at crossing SWC-CFA12-20. (CFA12-P19)	Ordinary watercourse	No status class shown in the RBMP – assumed status Moderate	No status class shown in the RBMP – assumed status Good	Moderate	Not applicable	Not applicable	The pond adjacent to the River Ray is directly connected with the river.
Culverted tributary of River Ray (Finemere Wood)	Will be crossed by the route north of Woodlands Farm. South-west of Finemere Wood. (SWC-CFA12-10)	Ordinary watercourse	No status class shown in the RBMP – assumed status Moderate	No status class shown in the RBMP – assumed status Good	Moderate	0.0003	0.52	The source of the tributary is an issue in Finemere Wood. It flows into an unnamed lake south of Finemere Wood and ultimately joins the River Ray north of Grendon Wood.
Unnamed lake south of Finemere Wood	Unnamed Lake that will be adjacent to the route, south of Finemere Wood. (CFA12-P20)	Ordinary watercourse	No status class shown in the RBMP – assumed status Moderate	No status class shown in the RBMP – assumed status Good	Moderate	Not applicable	Not applicable	The lake is online, fed by a tributary of the River Ray that rises in Finemere Wood. There is a jetty identified on the lake suggesting that it is used for leisure activities.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Unnamed drain	Will be crossed by the route south of Sheephouse Wood. The drain joins the Muxwell Brook. (SWC-CFA12-11)	Ordinary watercourse	No status class shown in the RBMP – assumed status Moderate	No status class shown in the RBMP – assumed status Good	Moderate	0.0003	0.62	The drain runs parallel to the existing railway track before flowing south into the Muxwell Brook and then the River Ray.
Ten unnamed ponds	Approximately 10 small isolated field ponds between Finemere Wood and Greatsea Wood will be north of the route (50m to 1km). (CFA12-P21)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Four unnamed ponds	Approximately four small isolated field ponds in the Greatmoor area will be south of the route (400m to 700m). (CFA12-P22)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water feature.
Muxwell Brook	Will be crossed by the route south of Sheephouse Wood. SWC-CFA12-12	Main river	No status class shown in the RBMP – assumed status Moderate	No status class shown in the RBMP – assumed status Good	Moderate	0.002	4.11	Muxwell Brook flows south-west from north of Balmore Wood, along the southern perimeter of Sheephouse Wood and eventually into the River Ray more than 3.5kms south of the route.
Two unnamed lakes	Two unnamed lakes will be immediately south of the route, to the south-west of Sheephouse Wood. (CFA12-P23)	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The lakes occupy disused clay pits and are not connected to any other surface water features in the catchment.

Water feature	Location description (Volume 5, Water Resources and Flood Risk Map Book map reference)	Watercourse classification ⁴	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value ⁵	Q95 ⁶ (m ³ /s)	Catchment area at crossing (km ²)	Notes
Two unnamed field drains	Two isolated field drains will be south of the route (440m to 850m) south of the clay pit lakes.	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drains are not connected to any other surface water feature.
Two unnamed field drains	Two small isolated field drains will be north of the route (200m – 300m) north of Sheephause Wood.	Not applicable	Not applicable	Not applicable	Low	Not applicable	Not applicable	The drains are not connected to any other surface water feature.

3.2.4 There are no licenced surface water abstractions within 1km of the route in the study area⁷. There is the potential for further unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

3.2.5 Table 2 of this report summarises surface water discharge consents within 1km of the route (see Maps WR-01-016 and 017, Volume 5, Water Resources and Flood Risk Assessment Map Book).

Table 2: Surface water discharge consents

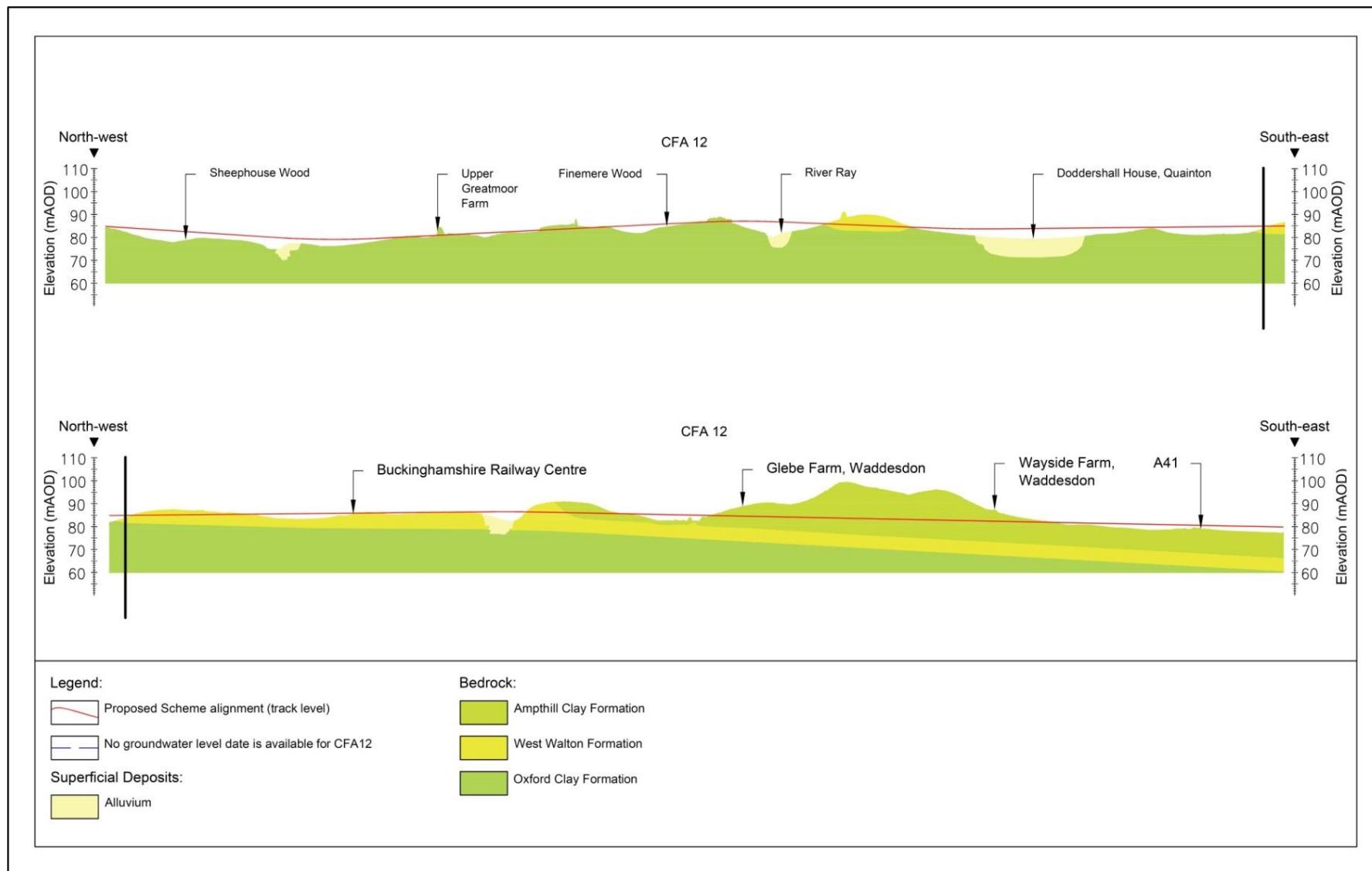
Reference number	Permit identifier	Distance (and direction) from route (in metres)	Discharge type	Receiving water body
CFA12WD4	CNTM.2194	145m (south-west)	Sewage discharge - final/treated effluent	Tributary of the Fleet Marston Brook
CFA12WD5	CTWC.3386	805m (south-west)	Discharge of other matter - surface water	Waddesdon Brook
CFA12WD7	CNTW.1183	155m (south-west)	Sewage discharge - final/treated effluent	Tetchwick Brook
CFA12WD18	CNTM.0636	450m (south-west)	Sewage discharge - final/treated effluent	Tributary of Fleet Marston Brook
CFA12WD45	CNTD.0052	170m (north-east)	Sewage discharge - final/treated effluent	Glebe Ditch/Tributary of Fleet Marston Brook
CFA12WD15	CNTM.0504	85m (west)	Sewage discharge - final/treated effluent	River Ray
CFA12WD43	TEMP.1882	805m (south-west)	Sewage discharge - final/treated effluent	Waddesdon Brook
CFA12WD42	TEMP.2987	220m (north-east)	Public sewage - storm sewage overflow	Fleet Marston Brook
CFA12WD35	CAWM.0809	451m (west)	Sewage discharge - final/treated effluent	Tributary of Doddershall Brook
CFA12WD37	CAWM.1314	901m (north-east)	Sewage discharge - final/treated effluent	Tributary of River Ray

⁷ Surface water abstractions for public supply are not included.

3.3 Groundwater

- 3.3.1 A summary of the geological units present in CFA12, along with their hydrogeological characteristics, is presented in Volume 2, CFA Report 12, Section 13.
- 3.3.2 Map WR-02-012 (Volume 5, Water Resources and Flood Risk Assessment Map Book) illustrates the spatial distribution of the uppermost superficial and bedrock formations within CFA12. A schematic cross-section along the line of the route in this area with regard to geological strata, groundwater level (where known) and the Proposed Scheme is presented in Figure 1.
- 3.3.3 Superficial drift deposits are absent from the majority of the area, with the exception of Alluvium, consisting of clay, silt, sand and gravel, associated with water courses, and an area of Head deposits consisting of clay, silt, sand and gravel to the north of Waddesdon.
- 3.3.4 Both the Alluvium and the Head deposits are classified as Secondary A aquifers.
- 3.3.5 From east to west along the route the bedrock geology consists of the following; the Ancholme Group comprising the Ampthill Clay Formation, West Walton Formation, Weymouth Member (Upper Oxford Clay), Stewartby Member (Middle Oxford Clay) and Peterborough Member (Lower Oxford Clay), as illustrated in Map WR-02-012, Volume 5, Water Resources and Flood Risk Assessment Map Book. Also within the Ancholme Group is the Kimmeridge Clay which comprises small outcrops that will not be crossed by the route. At the base of the Ancholme Group, below the Lower Oxford Clay, is the Kellaways Beds and the Great Oolite Group, both of which are classified as Secondary A and Principal aquifers respectively.
- 3.3.6 All these formations are classified as unproductive strata and do not have any meaningful quantities of groundwater in them.
- 3.3.7 There are no groundwater abstractions within 1km of the route. It should be noted, however, that there is the potential for further unlicensed abstractions to exist that have not been identified, as a licence is not required for abstraction volumes below 20 cubic metres per day.
- 3.3.8 There are no discharges to groundwater within 1km of the route in this study area.

Figure 1: Schematic geological cross-section for CFA12.



3.4 Surface water/groundwater interaction and water dependent habitats

3.4.1 Table 3 of this report summarises the surface water/groundwater interactions and water dependent habitats within 1km of the route.

3.4.2 The table identifies where a water dependency exists. The assessment of residual impact or mitigation measures on water dependent ecology receptors is found in the Ecology section in Volume 2, CFA Report 12, Section 7.

Table 3: Surface water/groundwater interaction and water dependent habitats.

Location description (Volume 5, Ecology Map Book, map reference)	Distance (m) and direction from route	Formation	Approximate elevation (m AOD)	Comments	Location description
Finemere Wood SSSI (Map EC-01-026, C5 to E2)	400m north	Ancholme Group (West Walton Formation/Weymouth Member)	90 – 130m AOD	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater.	Poorly drained soils give rise to marshy areas within the wood. A tributary of the River Ray rises at the north-east corner of the wood upstream of the route crossing SWC-CFA12-10.
Grendon and Doddershall Woods SSSI (Map EC-01-026, A10 to B10)	Nearest point is just over 800m south of the route but the length of river between the route and the SSSI is 1.6km.	Ancholme Group (Stewartby Member)	75m AOD	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater.	A tributary of the River Ray runs through Grendon Wood and supports sallow and alder. The SSSI is downstream of the route crossing SWC-CFA12-09.
Sheephause Woods SSSI (Map EC-01-027, E6 to G4)	Adjacent to the route	Ancholme Group (Peterborough Member)	75 – 100m AOD	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater.	The woodland is traversed by numerous small clay-lined streams and channels. These tributaries of the Muxwell Brook are upstream of the route crossings SWC-CFA12-11 and SWC-CFA12-12.
Grendon and Doddershall Meadows LWS (Map EC-01-026, F7 to H5)	Crossed by route	Alluvium	80m AOD	Shallow groundwater in the Alluvium is likely to be in connectivity with the LWS.	The LWS is designated for a damp neutral grassland.

4 Site specific surface water assessment

4.1 Summary of assessment

- 4.1.1 Table 4 summarises the potential impacts and effects to surface water features from the Proposed Scheme in the study area. Only those impacts and effects that are classed as significant are presented in Volume 2, CFA Report 12, Section 13.4.
- 4.1.2 Table 4 only includes water features which could potentially be impacted by the Proposed Scheme. Features such as isolated ponds and drains which will lie outside the construction footprint and area of impact of the Proposed Scheme are not included. Details of these features are provided in Table 1 of this report.
- 4.1.3 The draft Code of Construction Practice (CoCP) referred to in Table 4 sets out the measures and standards of work that will be applied to the construction of the Proposed Scheme (see Volume 5: Appendix CT-003-000/1). These will provide effective management and control of the impacts during the construction period.
- 4.1.4 The Proposed Scheme has been designed to control impacts on the water environment during operation through drainage design incorporating sustainable drainage systems (SuDS) features.

Table 4: Summary of potential impacts to surface water

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Two unnamed ponds north of Wayside Farm (SWC-CFA12-13)	Low	Waddesdon south cutting	Very small pond lost in vegetation north of Wayside Farm will be lost to cutting (SWC-CFA12-13). No impact to water resources resulting from the loss of pond.	Moderate impact Slight effect (Not significant)	No mitigation required for water resources. Any loss of asset will be covered under asset protection. Any ponds requiring mitigation for ecological purposes are discussed in Volume 2, CFA12 report, Section 7.	Minor impact Neutral effect (Not significant)	None	Minor impact Neutral effect (Not significant)	Construction (permanent)
Unnamed pond north of Glebe Farm (SWC-CFA12-14)	Low	Waddesdon south cutting Waddesdon embankment	Pond will be lost to cutting and embankment. No impact to water resources from the loss of pond.	Moderate impact Slight effect (Not significant)	No mitigation required for water resources. Any loss of asset will be covered under asset protection. Any ponds requiring mitigation for ecological purposes are discussed in Volume 2, CFA12 report, Section 7.	Minor impact Neutral effect (Not significant)	None	Minor impact Neutral effect (Not significant)	Construction (permanent)
Headwaters of the Fleet Marston Brook (SWC-CFA12-01)	High	New culvert and channel diversion Quainton south embankment Three balancing ponds and associated drainage	During works for the culvert at the Fleet Marston Brook and the balancing ponds and drainage, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further	Minor impact Moderate effect (significant)	Measures to be adopted in the design process Draft CoCP measures to control sediment mobilisation and risk of spills. Pre- and post-construction monitoring	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			details)						
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Headwaters of the Tetchwick Brook and tributaries (SWC-CFA12-02, SWC-CFA12-03, SWC-CFA12-15, SWC-CFA12-16 and SWC-CFA12-17)	Moderate	Quainton south embankment Culverts at crossing SWC-CFA12-2 and diversion of drain at SWC-CFA12-3 Road and overbridge (SWC-CFA12-15, SWC-CFA12-16 and SWC-CFA12-17) Four balancing	During works for the culverts and road works/bridge, balancing ponds and drainage, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further details)	Minor impact Slight effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		ponds and associated drainage	Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Six ponds at Upper South Farm (SWC-CFA12-18)	Low	Quainton cutting	The northern most pond of the group may be partially (5%) impacted by the cutting on the southern side of the route.	Minor impact Neutral effect (Not significant)	Nothing specific required	Minor impact Neutral effect (Not significant)	None	Neutral	Construction (permanent)
Unnamed drain and four ponds to the north of Upper South Farm (SWC-CFA12-04)	Low	Doddershall embankment Works on existing culvert and new culvert Balancing pond and associated drainage	During works for the culverting of the drain, balancing ponds and drainage there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further details)	Minor impact Neutral effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Unnamed drains ultimately flowing into Tetchwick Brook (SWC-CFA12-05, SWC-CFA12-06, SWC-CFA12-07 and SWC-CFA12-08) (SWC-CFA12-19)	Moderate	Doddershall embankment Six new culverts and diversion of drain to the south-east (SWC-CFA12-07) Stockpile (earthworks) Two balancing ponds and associated drainage	During works for the culverts at Doddershall Brook, balancing ponds and drainage, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction. Stockpile from the earthworks is currently designed to be positioned south of the route which would intercept the Doddershall Brook. (See Section 4.2 of this report for further details)	Minor impact Slight effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills from culvert works and stockpile materials.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Twelve unnamed ponds near Doddershall House and Shipton Lee (CFA12-P18)	Low	Doddershall embankment	Approximately three small ponds (partially overgrown with vegetation) may potentially be lost during construction activities. The other ponds will not be impacted by the Proposed Scheme. No impact to water resources from the loss of pond.	Moderate impact Slight effect (Not significant)	No mitigation required for water resources. Any loss of asset will be covered under asset protection. Any ponds requiring mitigation for ecological purposes are discussed in Volume 2, CFA12 report, Section 7.	Minor impact Neutral effect (Not significant)	None	Minor impact Neutral effect (Not significant)	Construction (permanent)
River Ray (SWC-CFA12-09)	High	Grendon Underwood embankment. Alteration to existing culvert. Balancing pond and associated drainage.	During works for the culvert at the River Ray, and the balancing pond and drainage, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills	Minor impact Moderate effect (Significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills. Pre- and post-construction monitoring.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			during construction. (See Section 4.2 of this report for further details)						
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Six unnamed ponds near Woodlands Farm (SWC-CFA12-20)	Low	Grendon Underwood embankment.	One pond will be partially lost during construction activities for the embankment. The other ponds will not be impacted by the Proposed Scheme. No impact to water resources from the loss of pond.	Moderate impact Slight effect (Not significant)	No mitigation required for water resources. Any loss of asset will be covered under asset protection. Any ponds requiring mitigation for ecological purposes are discussed in Volume 2, CFA12 report, Section 7.	Minor impact Neutral effect (Not significant)	None	Minor impact Neutral effect (Not significant)	Construction (permanent)
Tributary of River Ray (Finemere Wood) (SWC-CFA12-10)	Moderate	Grendon Underwood embankment. Works on existing culvert. Balancing pond	During works on the existing culvert, balancing pond and drainage there is potential for temporary impacts to flow.	Negligible impact Neutral effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		and associated drainage.	Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further details)						
				Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)
Unnamed lake south of Finemere Wood (CFA12-P20)	Moderate	Grendon Underwood embankment. Surface water drainage.	Change to local flow regime due to new surface water drainage system.	Minor impact Slight effect (Not significant)	Nothing specific required.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Unnamed field drain south of Sheephouse Wood (SWC-CFA12-11)	Low	Grendon Underwood embankment. New culvert. Balancing pond and associated	During works for the culverting of the drain, balancing pond and drainage there is a potential for temporary impacts to flow.	Negligible impact Neutral effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

Surface water feature/ receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		drainage.	Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further details)						
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway and associated infrastructure or spills.	Negligible impact Neutral effect (Not significant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (permanent)
Ten unnamed ponds between Finemere Wood and Greatsea Wood	Low	Grendon Underwood embankment	Approximately four very small field ponds that appear covered in vegetation will potentially be lost during construction activities for the embankment. The other ponds will not be impacted by the Proposed Scheme. No impact to water resources from the loss of pond.	Moderate impact Slight effect (Not significant)	No mitigation required for water resources. Any loss of asset will be covered under asset protection. Any ponds requiring mitigation for ecological purposes are discussed in Volume 2, CFA12 report, Section 7.	Minor impact Neutral effect (Not significant)	None	Minor impact Neutral effect (Not significant)	Construction (permanent)

Surface water feature/receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact and effect	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Muxwell Brook (SWC-CFA12-12)	Moderate	Grendon Underwood embankment Works on existing culvert.	During works on the existing culvert at the Muxwell Brook, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction. (See Section 4.2 of this report for further details)	Negligible impact Neutral effect (Not significant)	Measures to be adopted in the design process. Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	Negligible impact Neutral effect (Not significant)	Construction (temporary)

4.2 Detailed assessments

Assessment of potential impacts of surface water crossings

4.2.1 The locations and descriptions of the surface water crossings in this study area are given in Table 5.

Table 5: Proposals for surface water crossings

Water feature	Crossing map reference (Map WR-01-016 and WR-01-017)	Description	Length ¹ (m)	WFD water body, designation and status
Fleet Marston Brook	SWC-CFA12-01	Realignment and two culverts	73 and 60m	The Fleet Marston Brook will be crossed approximately 750m upstream of WFD water body Fleet Marston Brook, Denham Brook, Pitchcott Brook west (GB106039030420). Assumed Status Poor
Headwaters of the Tetchwick Brook	SWC-CFA12-02	Realignment and two culverts	61 and 24m	The drains converge just south of the route and then flow south-west to join the Tetchwick Brook some 2.9km from the route at SWC-CFA12-02. Assumed Status Poor
	SWC-CFA12-03	Diversion to drain at SWC-CFA12-02	Not applicable	
	SWC-CFA12-15	Diversion and culvert	12m	
	SWC-CFA12-16	Diversion and culvert	15m	
	SWC-CFA12-17	Diversion and culvert	18m	
Unnamed drain	SWC-CFA12-04	Three culverts (including work on an existing culvert)	12, 24 and 50m	Not applicable
Unnamed drains located north-east of Doddershall House.	SWC-CFA12-05	Two culverts	61 and 13m	The field drains merge just south of the route and flow to the east of Doddershall House before eventually joining Tetchwick Brook. Assumed Status Poor
	SWC-CFA12-06	Diversion and culvert	67m	
	SWC-CFA12-07	Diversion and two culverts	5 and 68m	
	SWC-CFA12-08	Three culverts	5, 17 and 46m	
Doddershall Brook and tributaries	SWC-CFA12-19	Stockpile (earthworks)	Not applicable	
River Ray	SWC-CFA12-09	Alteration to an existing culvert	27m	The River Ray and tributaries, north-east of Grendon Underwood GB106039030100 Moderate

Water feature	Crossing map reference (Map WR-01-016 and WR-01-017)	Description	Length ¹ (m)	WFD water body, designation and status
Culverted tributary of River Ray (Finemere Wood)	SWC-CFA12-10	Works on an existing culvert	134m	Joins the WFD water body River Ray and tributaries, north-east of Grendon Underwood Assumed status Moderate
Unnamed drain	SWC-CFA12-11	Diversion and existing culvert	37m	Joins the WFD water body River Ray and tributaries, north-east of Grendon Underwood Assumed status Moderate
Muxwell Brook	SWC-CFA12-12	Diversion and existing/ new culvert	46m	Joins the WFD waterbody Ray and tributaries, Northeast of Grendon Underwood Assumed status Moderate

¹The length is based on the consolidated construction boundary. The actual length of the culvert is to be confirmed and will be subject to agreement with the Environment Agency.

4.2.2 Through adherence to the requirements of the draft CoCP, including monitoring, significant effects during construction will be avoided.

4.2.3 Design mitigation will be used to address the potential construction permanent impacts of culvert crossings. The Environment Agency will be consulted on the design of the culverts and diversion proposals and any other mitigation measures. Mitigation measures will include:

- minimising the culvert lengths as far as possible, even if this requires some realignment;
- maintaining the natural bed profile within the channel, both in terms of channel gradients and substrates;
- maintaining natural flow depths, widths and velocities, (including natural variance and diversity) at the culvert inlet and outlet;
- constructing diversions and realigned channel sections in advance to allow stabilisation and vegetation growth to minimise sediment mobilisation when the flow is first diverted; and
- other measures, to be agreed with the Environment Agency, to ensure that the culverts are environmentally sympathetic to minimise their impacts on natural processes and biodiversity as far as possible.

4.2.4 The River Ray has an existing concrete culvert beneath the existing rail overbridge. For the Proposed Scheme the same course will be utilised for the new culvert. Works may include a temporary diversion to of the channel. This will be constructed in advance, and used in accordance with best practice as defined in the CoCP.

Adherence to the requirements of the CoCP will ensure significant effects are avoided during construction.

Highway Drainage

4.2.5 The Scope and Methodology Report (SMR) Addendum (Volume 5: Appendix CT-001-000/2) accompanying technical note (WAT5) on surface water quality assessment states that a Design Manual for Roads and Bridges⁸ (DMRB) Highways Agency Water Risk Assessment Tool (HAWRAT) assessment is required for re-aligned roads forecast to exceed an average annual daily traffic (AADT) value of 500 heavy goods vehicles (HGV).

4.2.6 A HAWRAT assessment has been undertaken for the A41 Bicester Road overbridge to the east of Waddesdon, where realignments of existing roads are required. The A41 Bicester Road overbridge (east of Blackgrove Road) is forecast to experience AADT of HGV of more than 500 HGV and an overall AADT greater than 10,000 (the threshold at which an assessment is required). The new road drainage will discharge to a local watercourse that is a tributary of the River Thame.

4.2.7 HAWRAT Step 1 assesses the quality of the direct highway runoff against permissible threshold values. The A41 Bicester Road overbridge fails Step 1 for the pollutants copper and zinc, and also for sediment.

4.2.8 Step 2 is a refinement of Step 1, which accounts for the nature and diluting capacity of the receiving water body. The A41 Bicester Road overbridge passes the assessment on all accounts at Step 2. Therefore at this early design stage no adverse impact on water quality is foreseen and no mitigation will be required.

4.2.9 The following assumptions were made in order to carry out this assessment:

- the impermeable road area drained was estimated from satellite imagery and ordnance survey maps;
- the baseflow index value for the watercourse has been taken as the HAWRAT default of 0.5; and
- a conservative watercourse width of 1m was estimated from satellite imagery.

4.2.10 For major roads, such as the A41, detailed assessments will be made during detailed design to inform the final discharge and treatment arrangements. Appropriate mitigation will be provided to address the risks to the receiving watercourses (for both flow and water quality) at the detailed design stage for the road re-alignments and will be selected using the DMRB (particularly HA103/06) and Construction Industry Research and Information Association (CIRIA) guidance⁹. The mitigation measures will be finalised at the detailed design stage. Remaining impacts will be negligible and the effect neutral as a result.

⁸ Department for Transport (2013). Design Manual for Roads and Bridges: <http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/hd4509.pdf>

⁹ Murname, E., Heap, A. and Swain, A. (2006). C648 Control of Water Pollution from Linear Construction Sites, CIRIA, London, UK.

5 Site specific groundwater assessment

5.1 Summary of assessment

5.1.1 Table 6 of this report summarises the potential impacts to hydrogeology (groundwater), abstractions, surface water/groundwater interactions and water dependent habitats. Only those impacts and effects that are classed as significant are presented in Volume 2, CFA Report 12, Section 13.4.

Table 6: Summary of potential impacts to groundwater receptors

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Hydrogeology (groundwater)									
Kellaway Beds and Great Oolite	Moderate (Kellaway Beds) High (Great Oolite)	Embankments (Bicester Road, Waddesdon, Quainton South, Doddershall, Woodlands, Adam's, Grendon Underwood 1 & 2). Cuttings (Waddesdon south and north, Quainton and partially Calvert). Auto-transformer station and feeder station. Overbridges and underbridges.	No work will take place below the mudstones of the Ancholme Group. It is assumed that the foundations of overbridges and underbridges will not penetrate through the mudstones. As a result, there is no potential for impact from these works on any groundwater present below the mudstones of the Ancholme Group. Therefore, the impact on groundwater in the bedrock is assessed as a neutral effect.	Negligible impact Neutral effect (Not significant)	Not required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable
Superficial deposits comprising mainly Alluvium	Moderate	Culverts for tributaries of watercourses associated with the Fleet Marston Brook, Doddershall Brook and River Ray. Swales, balancing ponds and other associated drainage.	Superficial deposits, comprising mainly alluvium (and some areas of Head), may contain shallow groundwater. The deposits are present along the tributaries of the Fleet Marston Brook, Doddershall Brook and River Ray. The superficial deposits are likely to be in hydraulic connectivity with the local watercourses. In all cases, the watercourses are crossed by	Moderate impact Slight effect (Not significant)	Foundations for the culverts will be constructed using good practice as described in the draft CoCP Draft CoCP measures to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary)

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			culverts. There is potential for surface water and subsequently shallow groundwater quality to be adversely affected by construction.						

Surface water/groundwater interactions and water dependent habitats

Finemere Wood SSSI	High	Adam's embankment and Grendon Underwood embankment No. 1.	This site is underlain by the Ancholme Group, a low permeability, unproductive strata. As such, there will be no reliance on groundwater to maintain the SSSI status. The SSSI is also upstream of the route (crossing number SWC-CFA12-10) so that there will be no potential for impact on the surface water regime in the SSSI either.	Negligible impact Neutral effect (Not significant)	Not required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable
Grendon and Doddershall Woods SSSI	High	Adam's embankment and Grendon Underwood embankment No. 1.	This site is underlain by the Ancholme Group, a low permeability, unproductive strata, As such there will be no reliance on groundwater to maintain the SSSI status. Site is downstream of SWC-CFA12-09 on the River Ray so there is potential for water quality impacts during	Negligible impact Neutral effect (Not significant)	Not required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable

Receptor	Receptor value	Design element	Discussion of potential impact to water receptor	Magnitude of potential impact	Avoidance and mitigation measures included in design	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
			construction. Impacts and mitigation are discussed under River Ray above.						
Sheephause Woods SSSI	High	Grendon Underwood embankment No. 2 and Calvert cutting.	This site is underlain by the Ancholme Group, a low permeability, unproductive strata. As such, there will be no reliance on groundwater to maintain the SSSI status. Site is upstream of SWC-CFA12-11 and SWC-CFA12-12 so that there will be no potential for impact on the surface water regime in the SSSI either.	Negligible impact Neutral effect (Not significant)	Not required	Negligible impact Neutral effect (Not significant)	None	None	Not applicable
Grendon and Doddershall Meadows LWS	High	Doddershall and Woodlands embankments.	This site is underlain by Alluvium over the Ancholme Group. Shallow groundwater in the Alluvium is likely to contribute to the nature of this damp and neutral grassland. Where the route will pass through this LWS, there will be an embankment. The area of Alluvium within the meadows that will not be within the construction boundary will be recharged under natural conditions and should continue to provide sufficient moisture to the remaining LWS.	Negligible impact Neutral effect (Not significant)	No specific water related mitigation required.	Negligible impact Neutral effect (Not significant)	None	None	Construction (temporary)

5.2 Detailed assessment

Influence of cuttings on groundwater

5.2.1 Table 7 summarises the potential impacts to groundwater from cuttings in this study area.

Table 7: Summary of influence of cuttings on groundwater

Cutting name	Geology penetrated	Groundwater elevation	Effect on groundwater resources	Mitigation required
Waddesdon south cutting	Amphill Clay Formation	Unproductive strata	No effect, no groundwater present	Not required
Waddesdon north cutting	Amphill Clay Formation	Unproductive strata	No effect, no groundwater present	Not required
Quainton cutting	West Walton Formation and Oxford Clay Formation	Unproductive strata	No effect, no groundwater present	Not required

6 References

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